MODSIMTex

Research in advanced textile manufacturing…

The Institute of Textile Research and Industrial Cooperation of Terrassa (INTEXTER) is a basic unit in the Universitat Politècnica de Catalunya (UPC), with its own administrative and functional structure. Its activities are addressed to encourage research and industrial cooperation in all the fields of the textile area and others related with it. INTEXTER activities cover two complementary areas that extend from the R&D of products and processes to the establishment of the most adequate mechanisms to open new ways of technological transfer and cooperation with industry through R&D projects. Another objective of INTEXTER is the training of technologists and researchers, which is done by imparting lectures in the doctorate courses.

The main activities of INTEXTER are related with the research in the following fields:

- Development and optimisation of textile production processes, new materials and technologies to manufacture;
- Polymers applied to novel and conventional textile raw materials;
- Surfactants and detergents applied to textiles;
- Development and optimisation of chemical textile processes;
- Industrial waste waters;
- Innovation and development within the multidisciplinary field of human and environmental toxicology.

One of the latest, biggest deals of INTEXTER has been the development of the project ModSimTex and its coordination. It is a European Commission Community Research 7th Framework Programme, priority four NMP project.

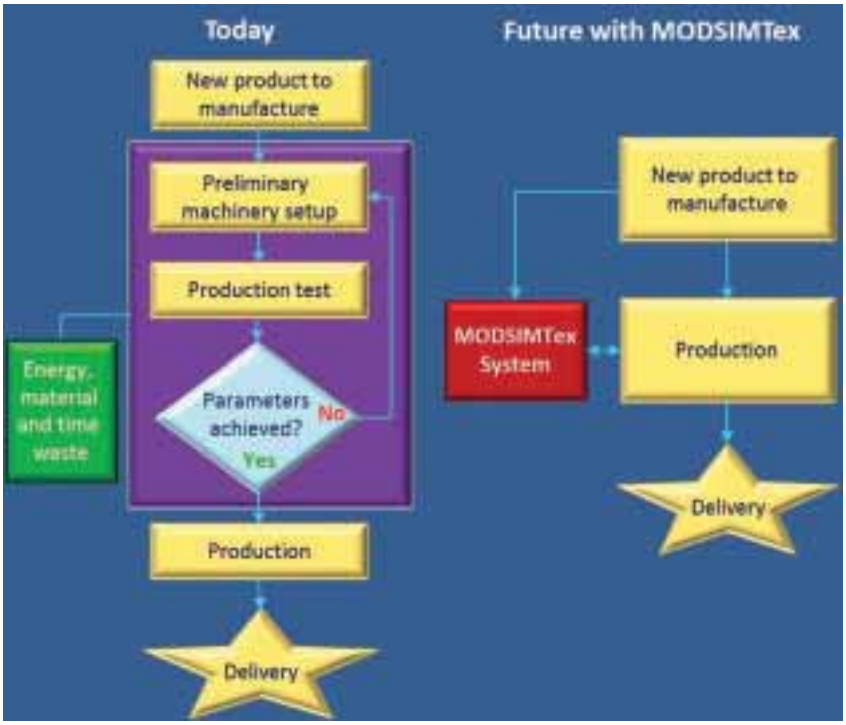
The objective of the project is to develop a system that will reduce dramatically the cost to develop new technical textile products by reducing the time, energy and raw material waste during the production machinery setup process. Its total budget is €4.5m and it is being developed between November 2008 and April 2012.

The project consortium comprises three universities, two research centres and seven companies from six different member states of the EU.

Description of the project

The textile industry faces important challenges regarding the production of new advanced textile products. It is not possible to define the characteristics and parameters of a given textile structure due to the difficulty of measuring them. This situation makes it very difficult to configure the machines involved in the production of such textiles; the typical practice is to manufacture samples and through trial and error adjust the processing operations until the desired characteristics are achieved in the final product. With this procedure it's very expensive to match the designer's idea with the final product. The production setup takes a long amount of time and efforts and increases the cost of the final product. This is especially critical when a company is trying to develop new technical textiles. This concept is shown in the figure below.

The vast majority of the existing systems capable of simulating textile products are limited to the visual representation, without any kind of mechanical or physical evaluation of the properties of the textile structures. Of course, these tools don't take into account the configuration of the production machinery, so they aren't capable of helping the setup of production machinery. Unlike these conventional design systems, the core of this project is to develop a virtual simulation system of the



physical-mechanical properties of the textile structures oriented to the fast setup of the machines involved in the whole textile chain manufacturing process (yarns, woven fabrics, knit fabrics, needle-punch non-woven, hydro-tangled non-woven and composite structures).

This virtual construction system will allow the prediction of the multifunctional textile performance before the actual textile is manufactured allowing the settings of the production machines to be either an input or an output of the computation thus reducing dramatically the effort and cost to produce small batches or develop a new advanced technological textile.

The currently available textile design software applications lack of any kind of mechanical or physical evaluation of the properties of the textile structures. Since their only mission is to represent the visual image of the yarns/fabrics, these software tools do not take raw materials, types of structures or their influence over the physical properties of the final textile into account. Hence these systems lack the ability to assist in the rapid manufacturing process configuration.

To overcome the described functionality limits of the currently available textile design systems, the objective of MODSIMtex is to develop a simulation system for the physical-mechanical properties of the textile structures that enables the rapid manufacturing process configuration. The system will support the product development and production for all products in textile value-added chain. The project has therefore the following main objectives:

- Development of the simulation model of the physical properties of the basic structural units that compose the multifunctional textile structures. Mathematical models will be developed to simulate the behaviour of the four textile structures studied in this project (yarns, woven fabrics, knit fabrics and non-woven fabrics). Starting from their manufacturing parameters and machinery setup;
- Development of a finite elements simulation system to simulate the physical properties of the textile structures, based on the mathematical models developed for these textile structures;
- Development of an artificial intelligence (AI) based simulation system for the physical properties of textile structures. This AI-based simulation system will complement the results of the finite elements simulation system to fill in the gaps where the finite elements system cannot simulate. The composition of both systems will generate a very strong and robust composed system that will generate precise results;
- Implementation of the two simulation models (finite elements and AI) in one single composed simulation system that will be the core of the MODSIMtex software package, which is the final milestone of the project;
- Integration of the simulation system results into the manufacturing process through the adequate interfaces, to produce real multifunctional textiles using the parameters established during the design process with the simulation software MODSIMtex. This way the design phase and the manufacturing phase are seamlessly integrated for the first time in the textile industry. This integrated software package MODSIMtex will be focused to the final user, and it will be the final deliverable of the project. The software will be divided into many modules oriented to each kind of machine inside the process, in order to be adapted specifically to it.

The research intended for this project has been developed by five textile institutes/universities, members of Autex and Textranet. Combining the knowledge of these organisations, the full spectrum of textile knowledge, and more specifically, the knowledge on the simulation of textile structures' physical properties is covered by this project. Almost all the investigation on this field is accumulated in this consortium.

The critical mass at the industrial participation level is excellent since this project has gathered two important European textile machinery constructors (Santoni and TFA) and three representative textile manufacturers in Europe (Heimbach, Röders, Sintex); the expertise of these five companies in the textile processes knowledge (manufacturing parameters, knowledge on the products, machinery) has been invaluable to develop the integration of the simulation software MODSIMtex in the textile machinery. This implementation has been crucial to achieve the precision manufacturing of multifunctional technical textile products. The achievement of developing the simulation software MODSIMtex is a huge breakthrough, but the inclusion of the simulation software into the textile machinery offers a new dimension and shapes a radically new set of opportunities to produce new multifunctional materials in a short time. At the same time, the consortium includes a textile software developer (Informàtica Tèxtil), which has the resources and capacity to achieve this integration. The required online analysis and metrology is completely assured by the participation of BMS, one major world leader in online textile monitoring and process control.

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